

# ASP Modeling Report

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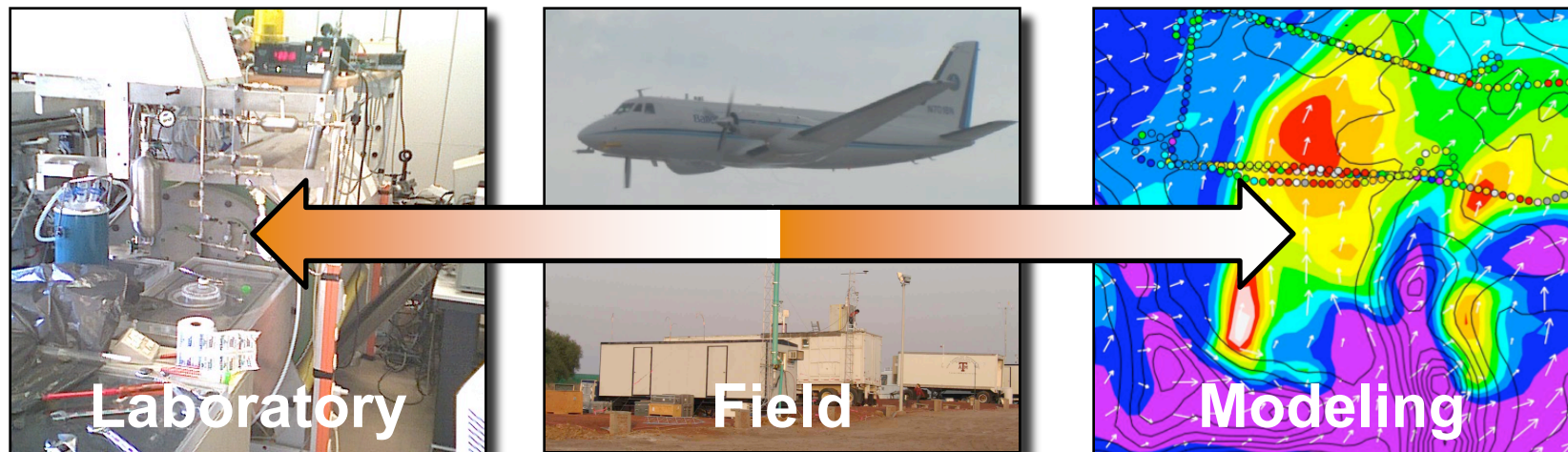
<http://www.asp.bnl.gov/ASPmodelingplan.pdf>



# Overview

- **Objectives of the Report:**

- Summarize ASP modeling activities for DOE clients
- Foster collaborative activities among ASP projects



- **Report describes:**

- Specific modeling activities and their major milestones
- Collaborations in ASP and with other programs
- Needs and future directions of modeling in ASP

# Report Status

- **Contributions:**
  - 26 ASP scientists responded – *Thank You!*
  - Table with brief description of primary activity
  - Appendix containing more detailed project objectives
  - List of milestones
  - Description of collaborative research
- Report finished end of **December 2008**
  - Corrections and additions?

# Part 1: Current Modeling Activities

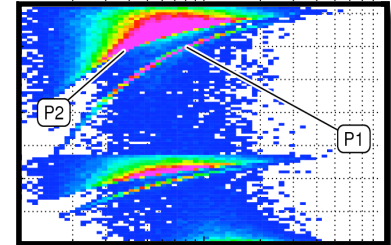
## Organized by Scales

- **Local Aerosol Property & Process (16)**

*new data  
& theory*

*thermodynamic  
models*

*box models*

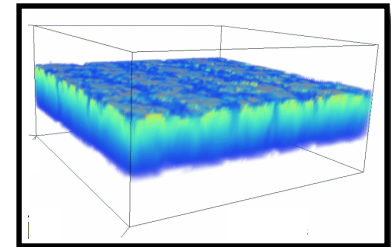


- **Local Cloud Property & Process (4)**

*new data  
& theory*

*parcel model  
representations*

*LES model  
representations*

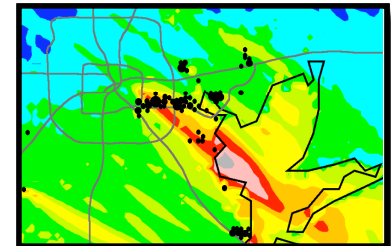


- **Regional Modeling (7)**

*uncertainty  
techniques*

*evaluating  
performance*

*parameterization  
development*

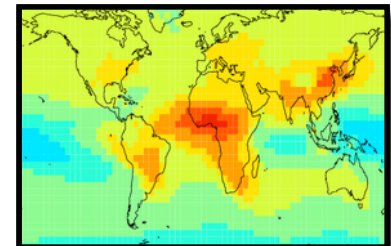


- **Global Modeling (3)**

*inverse  
modeling*

*evaluating  
performance*

*emissions*

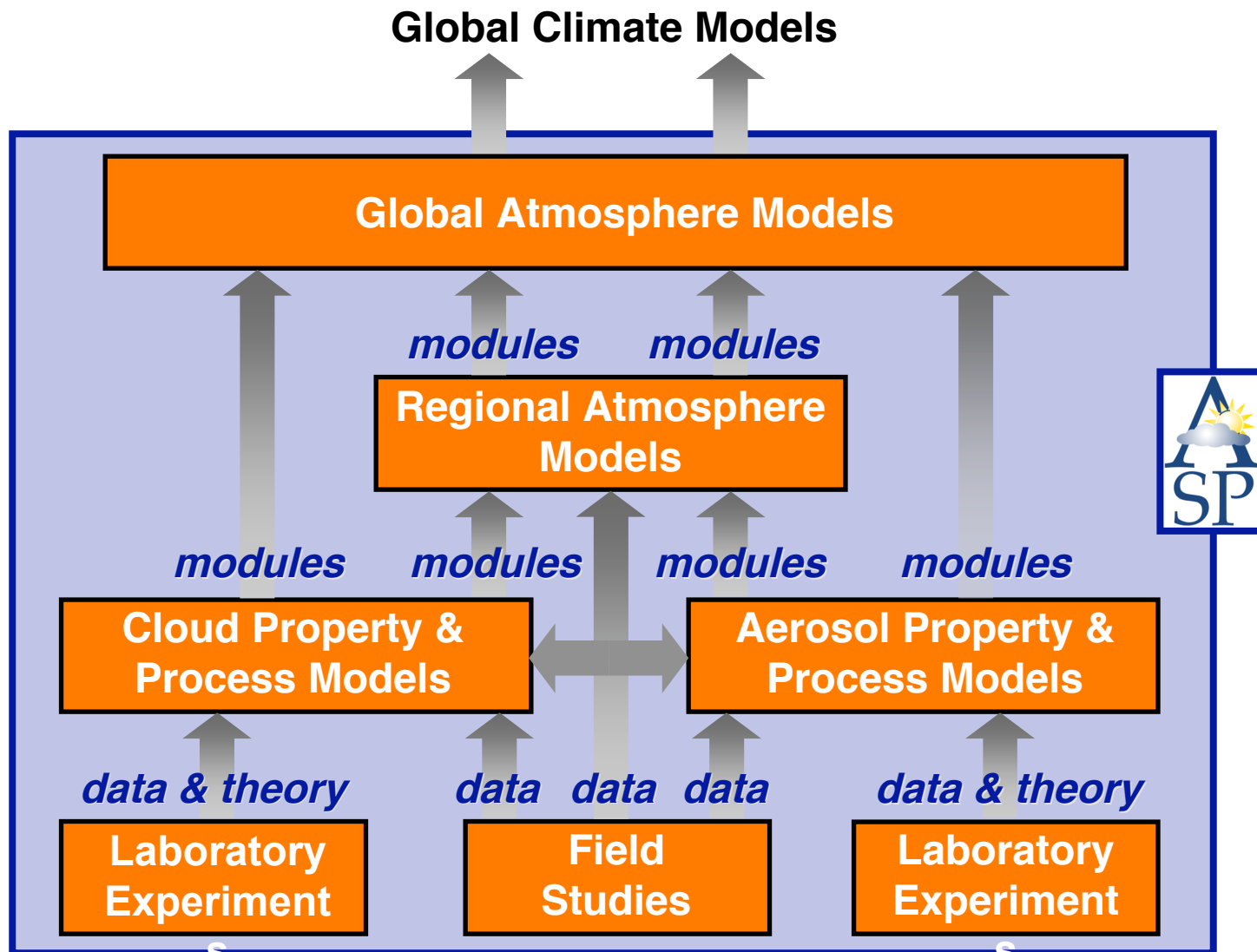


*Lots of overlap among these activities*



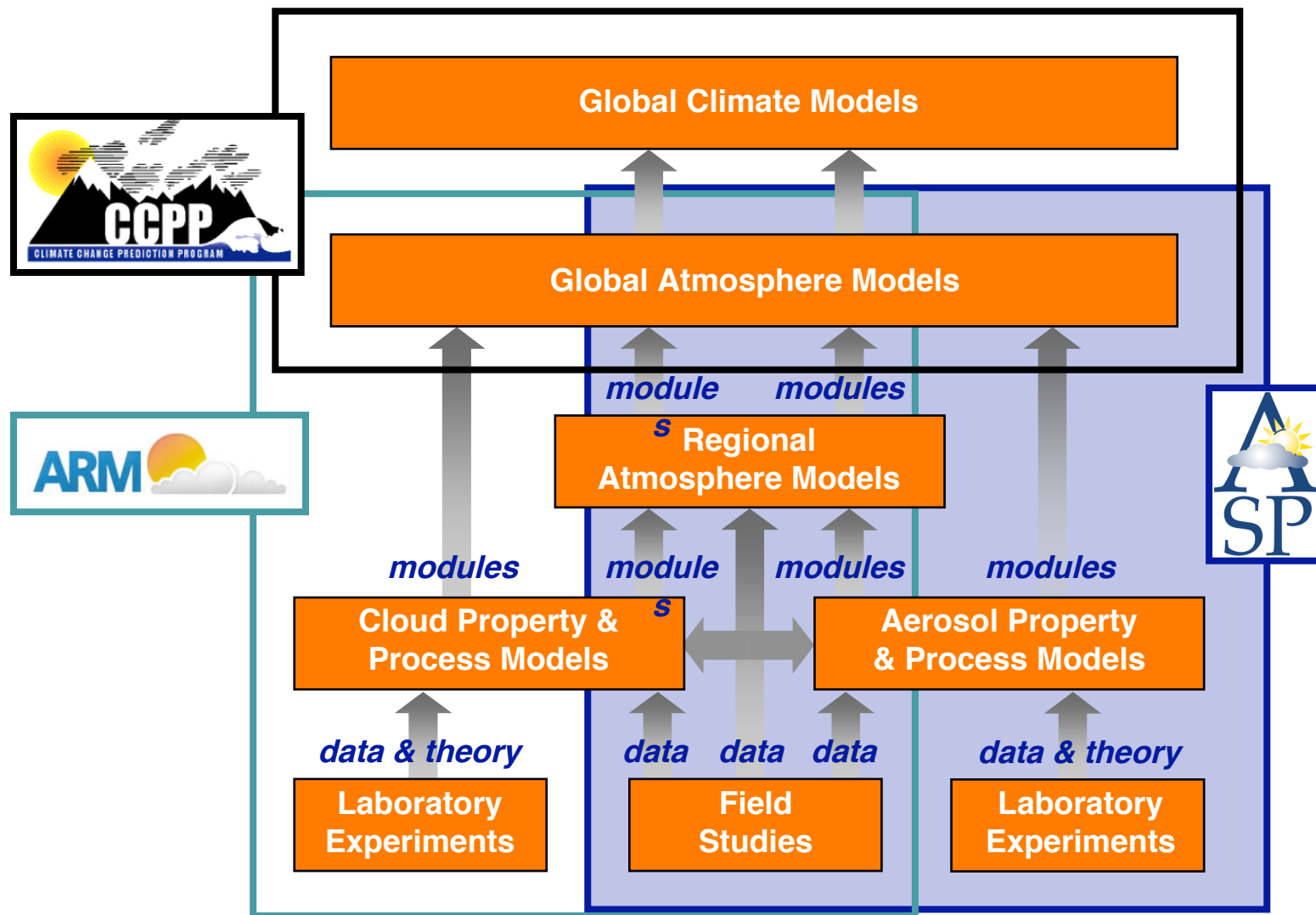
# Multi-Scale Approach

Adapted From Ghan and Schwartz, 2007, *Bull. Amer. Meteor. Soc.*



# Relationship with Other Programs

Adapted From Ghan and Schwartz, 2007, *Bull. Amer. Meteor. Soc.*



# Types of Modeling Research

- **Model Development:**
  - Design new and/or improved aerosol process modules and implement them into 3-D community models
- **Forecasting:**
  - Planning and conducting field experiments
- **Evaluation Studies:**
  - Determine the ability of predictive models to simulate the evolution of observed aerosol properties
- **Closure Studies:**
  - Constrain a portion of a model with measurements to evaluate a specific aerosol process
- **Insight Studies:**
  - Use models to address wide range of science questions that cannot be obtained from data alone

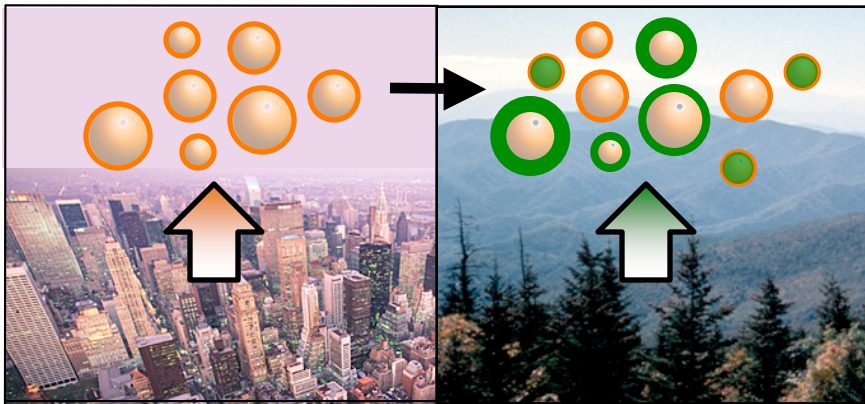
# Science Questions Related to Models

- Which aerosol processes are represented well or which are poorly represented in models?
- Which aerosol processes lead to large uncertainties in the magnitude and distribution of aerosol radiative forcing?
- What is the best way to better represent fundamental mechanisms associated with new particle formation and aerosol transformation processes?
- Do new treatments consistently improve the predictions of aerosol properties for the right reasons when compared with both laboratory and field experiments?
- What is the most appropriate balance between complexity of aerosol processes and computational efficiency?

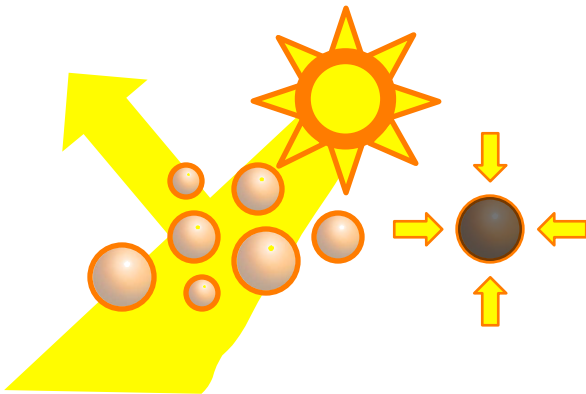
# Linkages Among Modeling Activities

## Three Major Themes

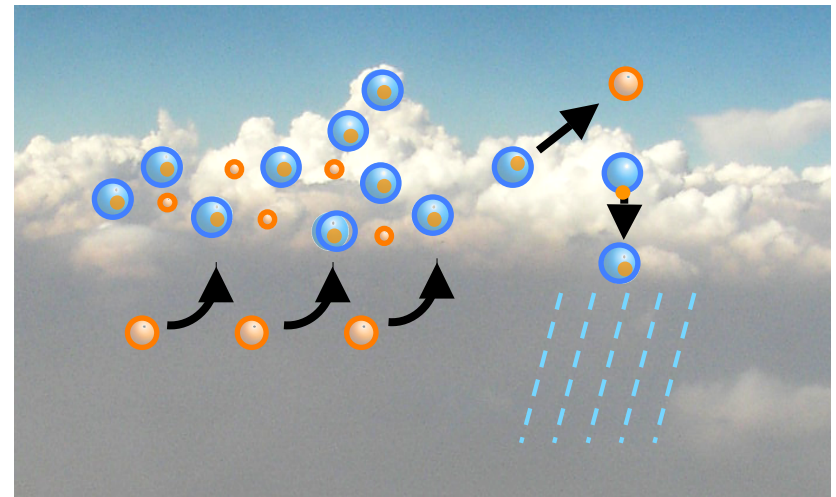
### 1) Secondary Organic Aerosols



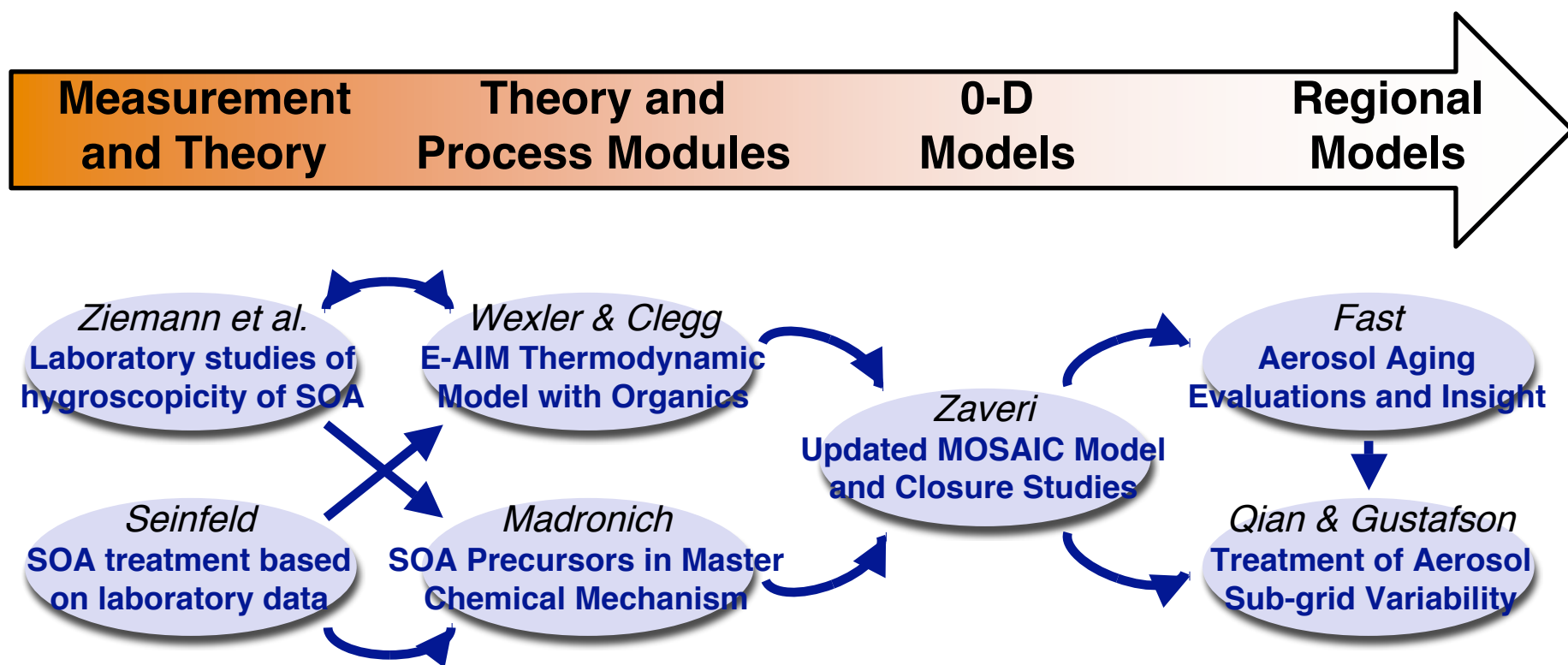
### 3) Aerosol Optical Properties



### 2) Cloud-Aerosol Interactions

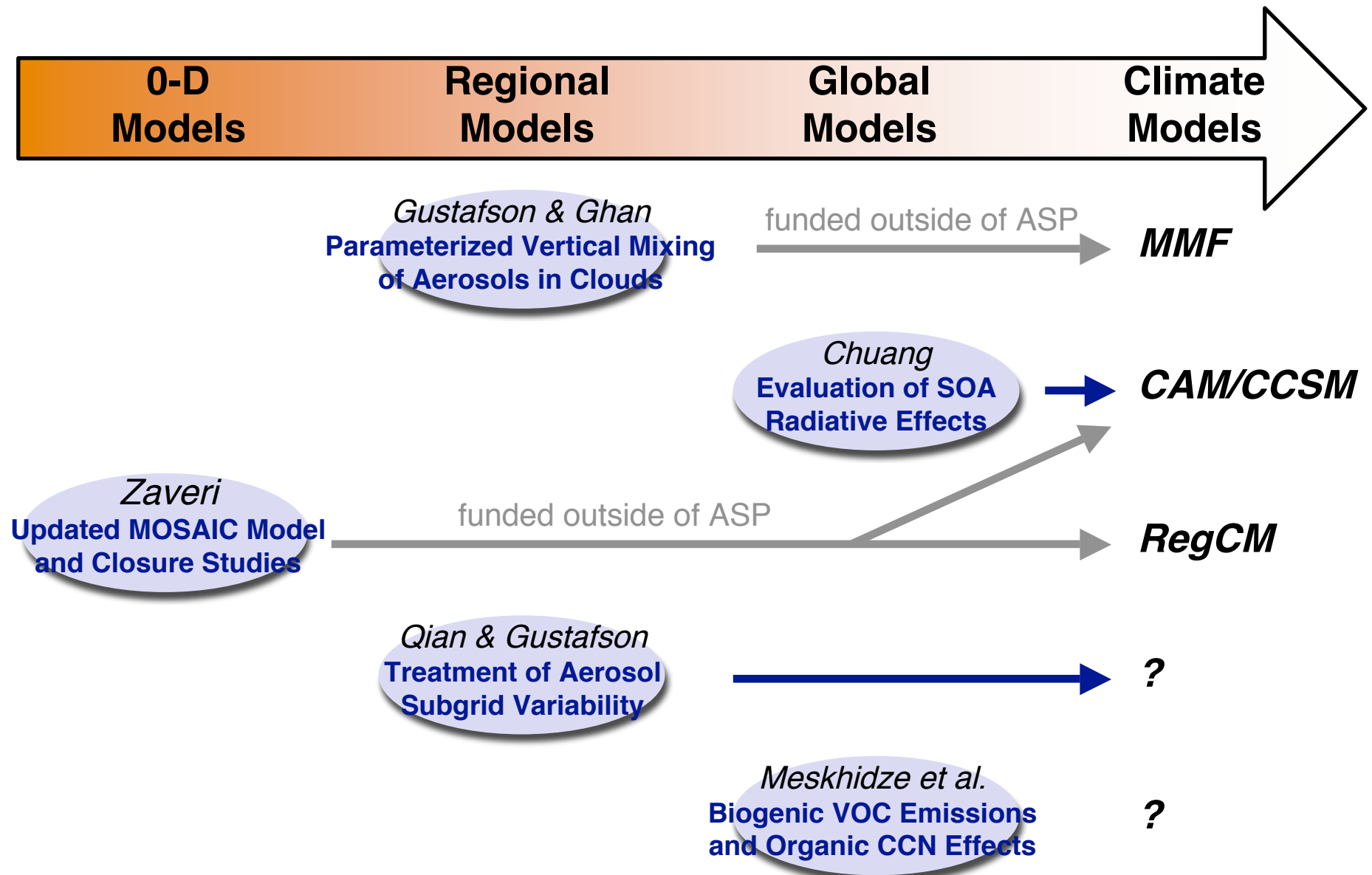


# Linkages Among SOA Activities



Several other SOA efforts as well

# Links to Climate Models

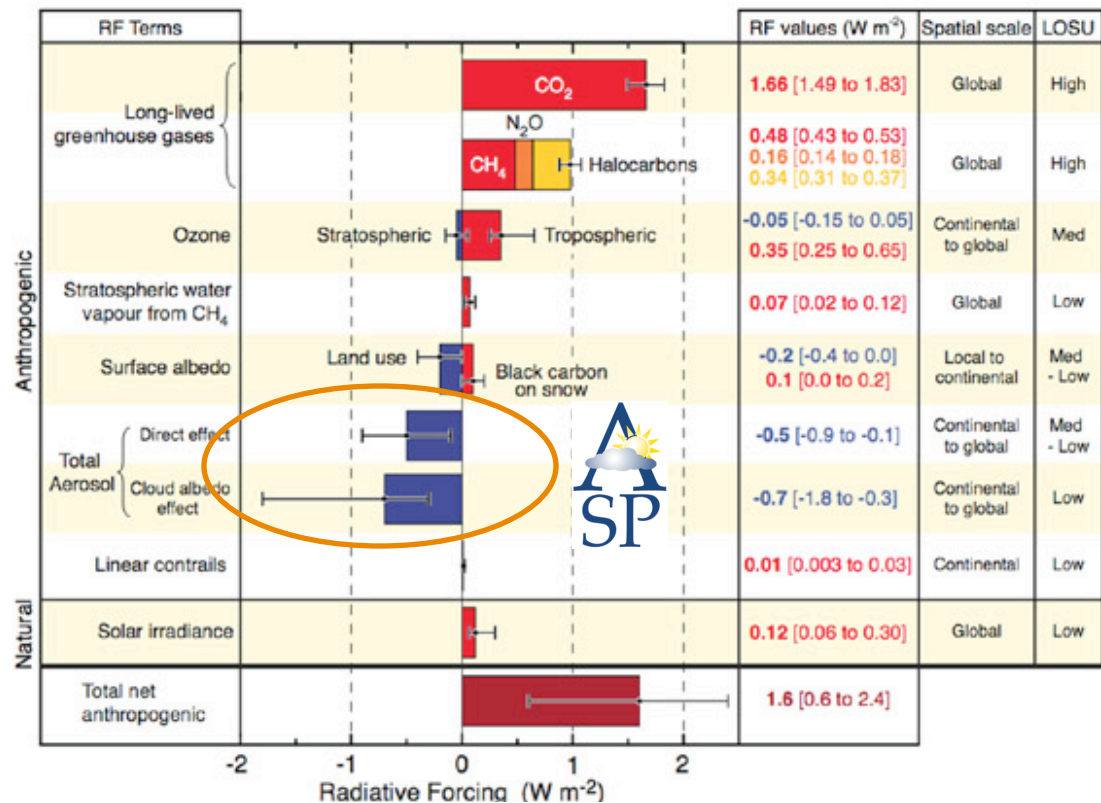




## Part 2: Needs and Future Directions

### IPCC: Radiative Forcing Components

Climate models still contain large uncertainties associated with aerosol radiative forcing



How can ASP *better address* this need?

# 1. Detailed Aerosol Process Models

Master Chemical Mechanisms  
Advanced Thermodynamics  
Particle Resolved Representations  
Cloud Resolving Modeling

## Examples

*complexity =  
computationally  
expensive*

## Benchmarks

for developing reduced mechanisms  
and new parameterizations

*not an easy task*

Current  
GCMs

Next Generation  
GCMs

***What about other complex approaches?***

## 2. Enhanced Collaboration

**Greater utilization** of ASP laboratory & field data:

- Measurements already being used by modelers to some extent, but ...
- Is there some valuable data not being taken employed for model evaluation or parameterization development?

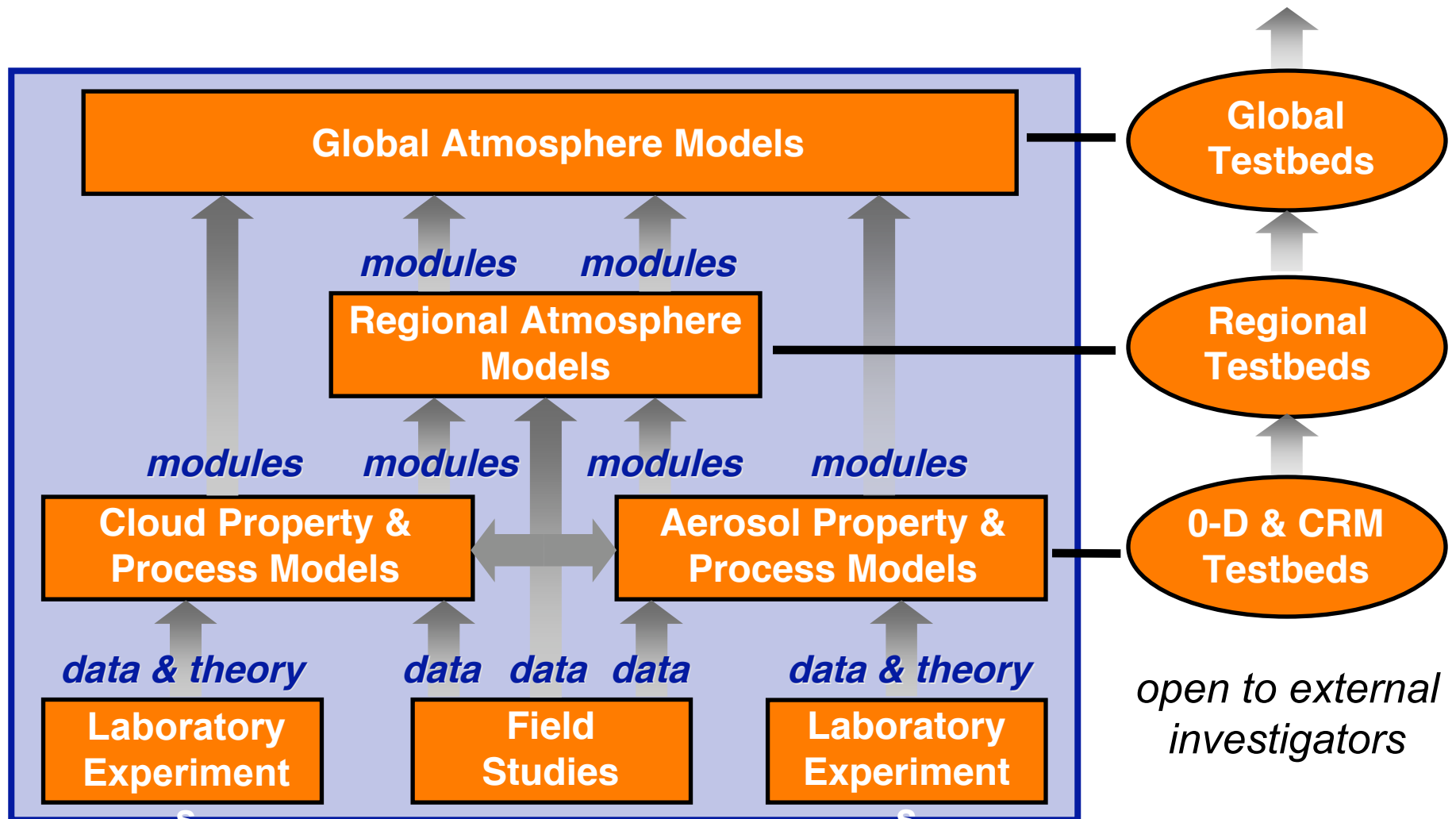


**Larger, more integrated projects ?**

- Integration of university and national laboratory projects
- Issues include: increased planning, timelines among investigators, deliverables complicated if one part is behind schedule or does not pan out

### 3. Aerosol Modeling Testbeds

- Community approach of objectively comparing performance of new aerosol process modules (see poster)



## 4. Fully Explore Parameter Space

### Current Approach:

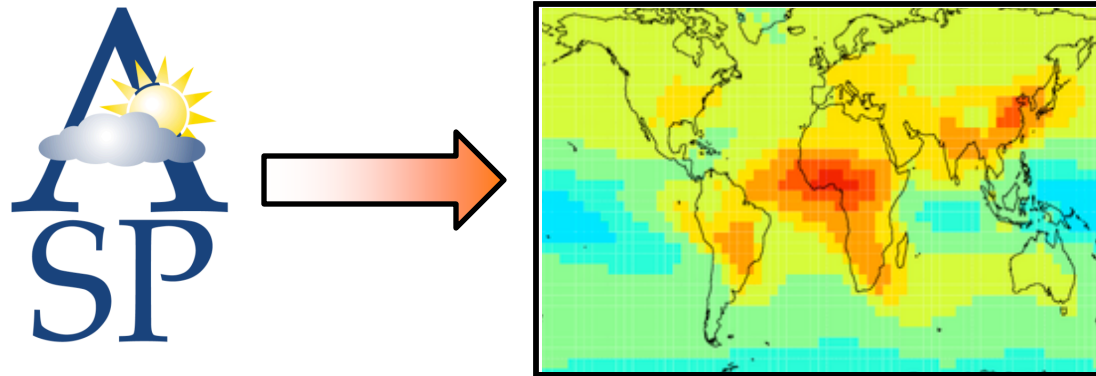
- Aerosol process modules compared with limited laboratory and/or field data
- 3-D aerosol models have “short” simulation periods and evaluated using “limited” observational data
- **Result:** performance is biased towards conditions in either the lab or field data; behavior for a wide range of conditions associated with climate simulations is not assessed

### Possible Solution: Longer Simulation Periods

- Parallel to longer-term ASP measurements ?
- Seasonal and multi-year simulations for 3-D models
- **Result:** A better understanding of the uncertainties and behavior of new process modules before they are used for climate studies

## 5. Global Climate Model Link

- Many aerosol process modules developed under ASP are being incorporated into GCMs by other DOE programs and agencies



- Expand ASP activities to include a GCM of choice ?
  - CAM / CCSM (funded by SciDAC)
  - Global WRF – but it's not a true climate model yet
- Liaison with climate modeling community ?
- Distinction between regional and global becoming blurred
  - Computer power continues to increase
  - Are GCM parameterizations valid at regional scales ?

# Summary

- Hopefully, these ideas may prove useful to address ASP planning questions associated with:
  - Aerosol life cycle
  - Aerosol direct effects
  - Cloud-aerosol interactions
- Comments or questions?